COMMENTS

I. Information Disclosure Statement

The Examiner has indicated that the Information Disclosure Statement that was filed with the application on October 13, 2000, was considered. It appears, however, that a copy of the initialed form PTO 1440 was not included with the Office action dated May 10, 2002. The Applicants kindly request the Examiner to send another copy of the initialed form PTO 1449 with his next correspondence.

II. Objection to Drawings

The specification has been amended in response to the Examiner's objection under 37 CFR 1.84(p)(5). In particular, reference sign "14" has been deleted from the specification to reflect that the fiber optic ribbon interconnect, which is discussed on page 7, line 26, is not shown in the drawings.

FIG. 6A has been amended in response to the Examiner's objection under 37 CFR 1.83(a). In particular, FIG. 6A has been amended to show diagrammatically that the integrated circuit 120 is formed on spacer substrate 80.

The Examiner's objections under 37 CFR §§ 1.84(p)(5) and 1.83(a) now should be withdrawn.

III. Status of Claims

Claims 1 and 2 have been canceled. Claims 21-27 have been added.

Claims 3, 4, and 11 have been rewritten in independent form. Claims 5-10, 12, and 21-24 depend from independent claim 4. Claims 25-27 depend from independent claim 13.

The Examiner has indicated that claims 9 and 10 would be allowable if rewritten in independent form.

IV. Claim Rejections Under 35 U.S.C. § 102(b)

The Examiner has rejected claims 1, 2, 11 and 12 under 35 U.S.C. § 102(b) over Feldman (U.S. 5,923,796). Claims 1 and 2 have been canceled. Claim 12 has been amended to depend from new independent claim 4 and, therefore, will be discussed below in connection with the rejection of claim 4 under 35 U.S.C. § 103(a).

Independent claim 11 requires that a characteristic dimension of the plurality of solder bumps be selected based upon a representative focal distance between the one or more optical devices and the one or more optical lenses. Feldman does not teach or suggest anything about the selection of a characteristic dimension of solder bumps. Indeed, Feldman only discloses that the solder bumps provide "precise lateral alignment between the transparent substrate 17 and the integrated circuit chips 13, 15" (col. 6, lines 39-40).

For this reason, the Examiner's rejection of claim 11 under 35 U.S.C. § 102(b) should be withdrawn.

V. Claim Rejections Under 35 U.S.C. § 103(a)

For the purpose of the following discussion, the examiner is reminded that:

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the references or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not on applicants' disclosure.

MPEP § 706.02(j). Furthermore, as pointed out by the Patent Office Board of Appeals and Interferences:

> The examiner should be aware that "deeming" does not discharge him from the burden of providing the requisite factual basis and establishing the requisite motivation to support a conclusion of obviousness.

Ex parte Stern, 13 USPQ2d 1379 (BPAI 1989).

A. Claims 1-3, 11, and 12

The Examiner has rejected claims 1-3, 11 and 12 under 35 U.S.C. § 103(a) over Feldman in view of Lebby (U.S. 5,337,397). Claims 1 and 2 have been canceled. Claim 12 has been amended to depend from new independent claim 4 and, therefore, will be discussed below in connection with the rejection of claim 4 under 35 U.S.C. § 103(a).

Independent claim 3 requires that the one or more optical lenses be recessed below the device bonding surface. With respect to the subject matter recited in claim 3, the Examiner has indicated that:

> ... the lens 102 [of Lebby] is recessed below the device bonding surface of the substrate 108.

Contrary to the Examiner's assertion, however, Lebby's lens device 102 is not recessed below a device bonding surface. Rather, Lebby merely teaches that the cladding surface 119 at the end of an optical waveguide 101 may be molded or milled to form a lens device 102. In other words, Lebby's lens device is formed at the cladding surface 119, not below the cladding surface 119.

Neither Feldman nor Lebby teach or suggest an optoelectronic device with one or more optical lenses recessed below a device bonding surface of an optical lens system. Furthermore, neither Feldman nor Lebby provides any motivation for recessing Lebby's lens device 102 below the cladding surface 119. Thefore, no permissible combination of the cited references could render independent claim 3 obvious under 35 U.S.C. § 103(a), and the rejection of independent claim 3 should be withdrawn.

<u>B. Claims 4-8, 12, and 21-24</u>

The Examiner has rejected claims 4-8 under 35 U.S.C. § 103(a) over Feldman in view of Wickman (U.S. 2002/0034363). In particular, the Examiner has indicated that:

> With regard to claims 4, 7, 8, Feldman et al. discloses all the subject matter claimed except the spacer substrate. However, Wickman et al. discloses an optical coupling device comprising the optical device system, which comprises a substrate 8 supporting an optical device 1; an optical lens system which comprises an optical substrate 5 incorporating the lens 14 and a device bonding surface defines one face of the spacer substrate 29. Note figures 4-7 of Wickman et al. It would have been obvious to one of ordinary skill in the art to form the optical lens system of Feldman et al. having a spacer substrate such as taught by Wickman et al. for aligning an array of optical devices with the optical elements.

Although it would have been obvious to modify Feldman's multi-chip module in accordance with Wickman's teaching, the resulting structure would not render obvious the optoelectronic device recited in independent claim 4. In particular, Wickman teaches a method of aligning an optical device array 8 with a transparent alignment substrate 5. In accordance with this method, the optical device array 8 and the transparent substrate 5 have complementary sets of alignment features 7 and 29 that are designed to "guide the array 8 into precise alignment with the substrate 5" (paragraph 0023 of Wickman). This is the same function that is provided by Feldman's complementary solder bumps 24 and electrical contact pads 20-23 ("the flip-chip bonding technique provides precise lateral alignment between the transparent substrate 17 and the integrated circuit chips 13, 15"; col. 6, lines 38-40 of Feldman). Thus, one of ordinary skill in the art would have viewed the alignment techniques of Feldman and Wickman as substitutes. Accordingly, if one of ordinary skill in the art were to modify Feldman in accordance with the teachings of Wickman, that person would have replaced Feldman's solder bumps 24 and electrical contact pads 20-23 with Wickman's alignment features 7 and 29. The combination of Feldman and Wickman therefore would not result in the optoelectronic device recited in independent claim 4.

Moreover, contrary to the Examiner's implication, there is no teaching or suggestion in either Feldman or Wickman that would suggest modifying Feldman's multi-chip module by attaching the patterned polyimid layer 29 to Feldman's hologram substrate 17 without also

attaching the complementary alignment features to the integrated circuit chips. Indeed, without both the patterned polyimid layer 29 and the alignment features 7, Wickman's alignment method would not work, defeating Wickman's objective to provide "a methodology for accurately aligning optical components to one another, using features applied to the optical components" (paragraph 0005). A modification of Wickman's teachings that defeats the object of his invention hardly would have been obvious to one of ordinary skill in the art. Since the references themselves do not provide any motivation for the selective combination of features suggested by the Examiner, it appears that the Examiner has impermissibly engaged in hindsight reconstruction of the claimed invention, using the Applicants' structure as a template and selecting elements from the cited references to fill the gaps.

For at least the reasons explained above, the Examiner's rejection of independent claim 4 under 35 U.S.C. § 103(a) should be withdrawn.

Claims 5-8, 12, and 21-24 incorporate the features of independent claim 4 and, therefore, these claims are patentable for at least the same reasons.

C. Claim 13

The Examiner has rejected independent claim 13 under 35 U.S.C. § 103(a) over Feldman in view of Wickman. The Examiner, however, has failed to explain the basis for this rejection. In any event, the Applicants submit that the rejection should be withdrawn for the same reasons explained above in connection with the Examiner's rejection of independent claim 4.

New claims 25-27 incorporate the features of independent claim 13 and, therefore, these claims are patentable for at least the same reasons.

VI. Conclusion

For the reasons explained above, all of the pending claims are now in condition for allowance and should be allowed.

Charge any excess fees or apply any credits to Deposit Account No. 50-1078.

Respectfully submitted,

Date: August 2, 2002

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APPENDIX

Marked-up versions of the amendments made by the Response to the Office action dated January 30, 2002, are presented below.

In the Specification:

Please replace the paragraph at page 7, lines 1-27, with the following paragraph:

-- Referring to FIG. 2, in one embodiment, optoelectronic device 10 includes an optical device system 40 having an optical device substrate 42 supporting an optical device 44 (e.g., a light detector, such as a p-i-n diode, or a light-emitter, such as a VCSEL) and a solderable metallization pattern 46, 48 having a spatial arrangement with respect to optical device 44. Optoelectronic device 10 also includes an optical lens system 50 having an optical element 52 and a device bonding surface 54 supporting a solderable metallization pattern 56, 58 with a spatial arrangement with respect to optical element 52. The metallization patterns 46, 48 and 56, 58 may match identically or they may be different, in either case, however, the metallization patterns 46, 48 and 56, 58 are arranged so that when they are solder bonded together optical device 44 and optical element 52 are aligned. Optical element 52 may include a device-side optical lens 60 and a fiber-side optical lens 62. Optical lenses 60, 62 may be diffractive or refractive optical lenses formed on an optical substrate 64 (e.g., a glass substrate). Optoelectronic device 10 further includes a plurality of solder bumps 66 disposed between the metallization patterns 46, 48 and 56, 58. During manufacture, solder bumps 66 originally are disposed on metallization pattern 56, 58 of optical lens system 50. Optical device substrate 42 is aligned with optical substrate 64 to within an accuracy required for solder bumps 66 to contact the metallization pattern 46, 48 of optical device system 40. The assembly then is raised to a temperature at or above the melting point of solder bumps 66. Solder bumps 66 wet [wets] the solderable metallization pattern 46, 48 and surface tension forces pull optical substrate 64 and optical device substrate 42 in very precise alignment (e.g., to within ± 4 μm). The assembly is cooled to form a solidly bonded, accurately aligned structure. This bonded structure may be incorporated into a header block of a transceiver module and aligned with the optical fibers of a fiber optic ribbon interconnect [14] using conventional ferrule-based alignment technology.--

In the claims:

3. (Amended) An optoelectronic device, comprising:

an optical device system comprising an optical device substrate supporting one or more optical devices and a solderable metallization pattern having a spatial arrangement with respect to the one or more optical devices;

an optical lens system comprising one or more optical lenses and a device bonding surface supporting a solderable metallization pattern having a spatial arrangement with respect to the one or more optical lenses [The optoelectronic device of claim 1], wherein the one or more optical lenses are recessed below the device bonding surface; and

a plurality of solder bumps disposed between the metallization patterns of the optical device system and the optical lens system;

wherein the plurality of solder bumps bond the optical device substrate to the device bonding surface with the one or more optical devices aligned with the one or more optical lenses.

4. (Amended) An optoelectronic device, comprising:

an optical device system comprising an optical device substrate supporting one or more optical devices and a solderable metallization pattern having a spatial arrangement with respect to the one or more optical devices;

an optical lens system comprising one or more optical lenses and a device bonding surface supporting a solderable metallization pattern having a spatial arrangement with respect to the one or more optical lenses [The optoelectronic device of claim 1], wherein the optical lens system comprises an optical substrate incorporating the one or more lenses and the device bonding surface defines one face of a spacer substrate; and

a plurality of solder bumps disposed between the metallization patterns of the optical device system and the optical lens system;

wherein the plurality of solder bumps bond the optical device substrate to the device bonding surface with the one or more optical devices aligned with the one or more optical lenses.

11. (Amended) An optoelectronic device, comprising:

an optical device system comprising an optical device substrate supporting one or more optical devices and a solderable metallization pattern having a spatial arrangement with respect to the one or more optical devices;

an optical lens system comprising one or more optical lenses and a device bonding surface supporting a solderable metallization pattern having a spatial arrangement with respect to the one or more optical lenses; and

a plurality of solder bumps disposed between the metallization patterns of the optical device system and the optical lens system, wherein the plurality of solder bumps bond the optical device substrate to the device bonding surface with the one or more optical devices aligned with the one or more optical lenses, and [The optoelectronic device of claim 1], wherein a characteristic dimension of the plurality of solder bumps is selected based upon a representative focal distance between the one or more optical devices and the one or more optical lenses.

12. The optoelectronic device of claim 4 [1], wherein the one or more optical devices comprises a vertical cavity surface emitting laser or a detector, or both.

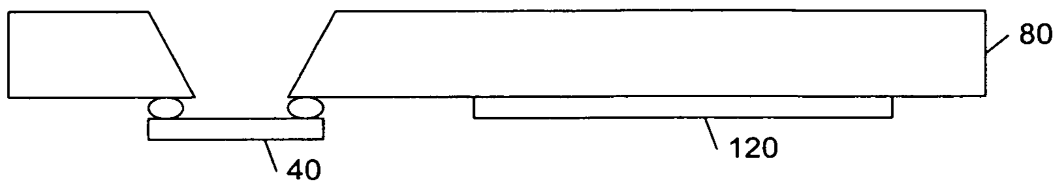

FIG. 6A

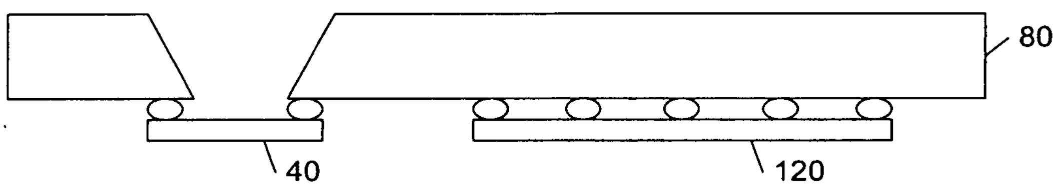

FIG. 6B

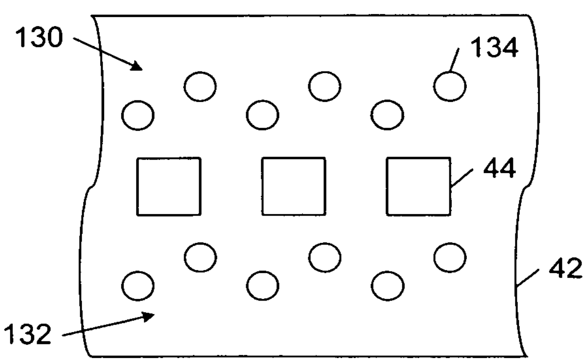

FIG. 7A

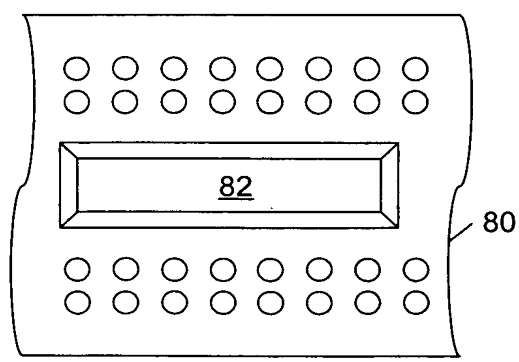

FIG. 7B